EXECUTIVE SUMMARY

This report provides a summary of the findings and recommendations from a three phase Watts Branch Watershed Study and Management Plan project conducted by the Center for Watershed Protection (Center), Environmental Systems Analysis (ESA), and Macris Hendricks, & Glascock (MHG) for the City of Rockville, MD Department of Public Works. The primary goal of the Watts Branch project was to develop a watershed protection plan that establishes a program aimed at mitigating many of the impacts and stresses that exist on the ecosystem. Specific watershed protection goals of the plan, as identified by the City and its residents, include:

- Minimize/control channel enlargement (i.e., channel erosion)
- Reduce pollutant loadings from nonpoint source runoff
- Develop stewardship among residents by educating and changing behaviors
- Protect existing utilities in and near streams from erosion damage
- Provide stormwater management control over a significant proportion of the watershed (or subwatershed)
- Protect existing forest areas
- Protect existing wetlands
- Protect existing active recreational areas

The watershed study and management plan for Watts Branch employed principles of a rapid watershed planning approach, with an emphasis on "stakeholder" involvement. The City needed a workable plan for implementation of specific management measures that balanced the inevitable tradeoffs between environmental protection and an urban population. To develop the right balance, the City staff formed a partnership with interested residents, civic and homeowners' association representatives, and environmentally concerned citizens to review the methodology, findings and recommendations of the study. The Watts Branch Partnership helped tailor proposed projects to meet neighborhood needs as much as possible and still achieve the watershed objectives. The Partnership members also acted as liaisons to their communities to inform people of the watershed study and convey comments back to the staff.

The first phase of the project was a watershed assessment and preliminary plan development stage, where the existing conditions within the watershed were documented and potential management measures are put forth. Specific tasks included:

- Conducting a stream geomorphic assessment to assess the dynamic stream evolutionary process associated with altered urban hydrology
- conducting a biological, physical and chemical stream survey to identify overall stream health and identify specific problem areas
- Identifying potential stream rehabilitation and stormwater retrofit sites within the watershed
- Facilitating a watershed planning charette to engage watershed stakeholders in the planning process, and
- Preparing preliminary recommendations for employing management measures.

A Phase I Watts Branch Watershed Study Report was prepared and submitted to the City in March, 2000, describing in detail the findings of the above tasks.

In the second phase, the project team prepared conceptual designs, cost estimates and analyses of estimated benefits for specific watershed management measures such as stormwater management retrofits, stream rehabilitation, wetland enhancement, and forest conservation.

In the third and final phase, the project team developed management recommendations for public outreach and education, bench mark and long term monitoring, and prioritization of implementation.

E.1 Background

Watts Branch is a tributary to the Potomac River located in suburban Maryland approximately 15 miles northwest of Washington, DC. The Watts Branch watershed area within the City of Rockville limits is approximately 6.5 square miles and has over 18 miles of streams. This area includes all of the headwater streams of the watershed. In general, the mainstem of Watts Branch flows from north to south.

The land use within the watershed is comprised of a mixture of residential, commercial, and institutional, with single family residential being the most common land use. The current impervious cover for the Watts Branch watershed within the City of Rockville is approximately 28 percent. The impervious cover is an important and useful indicator that can be used to define what current watershed conditions are as well as to formulate realistic goals for what the prospects are for improvement in response to mitigation and rehabilitation efforts.

Existing water quality and macroinvertebrate data indicate that over time, there has been a decline in water quality and the diversity in the benthic macroinvertebrate communities. An obvious factor has been the nearly continuous conversion of this watershed from agricultural to urban land use over the last 50 years. With the current and planned development of the last two significant parcels of contiguous land (King Farm and Fallsgrove), the Watts Branch watershed will reach a condition known in the land planning world as essentially full "buildout."

The Watts Branch watershed is somewhat unique in that it is a rare example of a watershed that has been scientifically studied over time. The renowned fluvial geomorphologist, Dr. Luna Leopold, had the foresight to study in detail the Watts Branch watershed over a 20-year period (1953 to 1972) in an attempt to establish a database from which to track and analyze changes in a small headwater channel. Leopold observed a trend of initial aggradation followed by degradation (i.e., channel enlargement) in Watts Branch. The enlargement has continued through the 1990s and can be directly related to the degree and rate of urbanization. The adverse impacts associated with the channel enlargement are a major reason for this watershed planning effort.

Watts Branch was analyzed during the first phase of the project using a suite of rapid watershed diagnostic techniques including: the impervious cover model, the Rapid Geomorphic Assessment (RGA), the Rapid Stream Assessment Technique (RSAT), and hydrologic modeling (TR-20). The impervious cover model was used to assist in establishing realistic watershed management objectives, the RGA was performed to evaluate channel stability, and the RSAT was implemented to determine the physical attributes of all perennial reaches of Watts Branch. Hydrologic modeling was undertaken to provide additional runoff information to use in assessing the geomorphologic status of the stream, to assess the effect of existing and proposed stormwater facilities, to use for

conceptual designs for stormwater facilities and to update the study previously prepared for the City. In addition, stormwater retrofit and stream rehabilitation inventories were conducted, in which potential retrofit sites were identified and conceptual-level sketches were developed.

The Phase I information was in turn used to develop and refine conceptual-level designs of stormwater retrofit and stream rehabilitation sites. A series of "30%" design drawings showing plan and profile details were developed for the priority sites. In addition, wetland improvement and reforestation recommendations were developed based on the reconnaissance level information collected during the rapid field assessments.

The project approach also placed an emphasis on getting input and involvement from the public early in the planning process through workshops and Partnership meetings. The project scope was developed to ensure that public involvement and participation remains a component of the watershed plan well after the immediate project.

E.2 Analysis

An important task of the Watts Branch project was to define the stream channel geomorphic characteristics. The assessment of the physical characteristics of the stream channel serves as an important foundation of the stream rehabilitation strategies and provides a reference on where the stream is in its evolutionary process. In addition, the documentation of current channel conditions can be used as an indicator of future trends in stream channel characteristics.

Streams characteristically enlarge as result of urbanization. Past investigations have found that channel enlargement is a function of basin imperviousness as well as the corresponding age of that impervious cover. The simplest way to quantify these changes is to define an "enlargement ratio," which represents the ratio of a stream's current cross-sectional area to its pre-development cross-sectional area (or, in some cases, a cross-section from an adjacent undeveloped stream of equivalent watershed area.)

To illustrate the concept of channel enlargement, Figure E.1 is presented comparing a channel cross-section as it evolves over time. The change in channel morphology is illustrated by superimposing the cross-sectional area of a channel at three distinct points in time: historic, current, and ultimate. Historic cross-section data are obtained from past surveys (often obtained from transportation agencies or public works departments that conducted surveys at the time of road construction or improvement projects), current cross-sectional data are obtained from field surveys conducted at the time of the study, and ultimate cross-sectional data are generated using predictive (i.e., empirical) equations based, in part, on the historic and current cross-sections.

The channel enlargement analysis documented some important findings about where Watts Branch is along the evolutionary time line. In general, it appears that the Watts Branch channels are only about 30 to 40 percent of the way along the evolutionary process. Therefore, another 40 to 50 years of channel reaction and adjustment to development influences is expected before a state of quasi-equilibrium is reached. In addition, the channel cross-sectional area is expected to increase two to four times its current size, depending on the location.

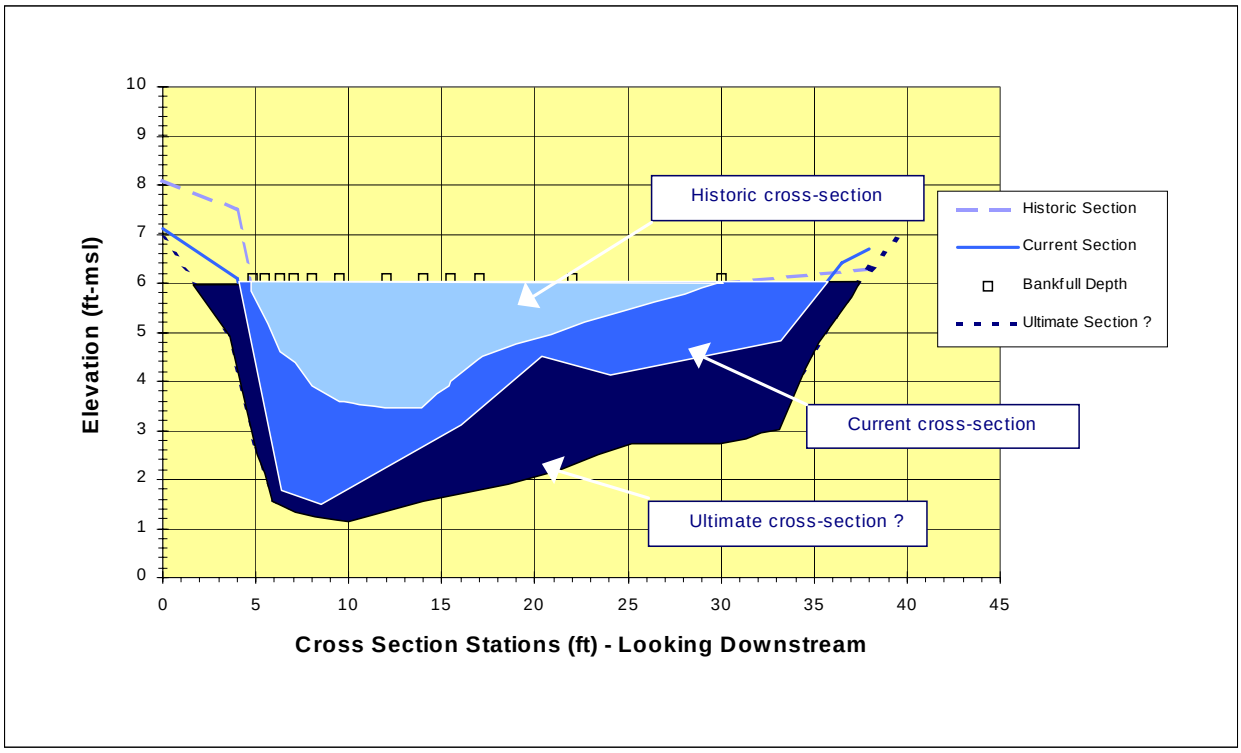


Figure E.1 Watts Branch cross-section comparison (Note: cross-sections have been overlaid for illustrative purposes only–actual sections do not share same datum.)

These findings were important to the overall strategy that was taken from a stream rehabilitation and stormwater retrofit standpoint. Specifically, since the study points indicate that the stream channel still has a long way to go before reaching a state of relative equilibrium, the in-stream rehabilitation techniques implemented for the most part focused on practices able to withstand adjustments in channel downcutting, widening, and plan form. It should be noted that there are certain reaches that required more substantial channel protection measures (e.g., imbricated riprap) where property or utility crossing impacts was a primary consideration. In addition, because there is a large increase in channel cross-sectional area predicted, an important focus of the stormwater retrofitting was on providing channel protection storage (i.e., 24-hour extended detention of the 1-year return frequency storm) to help mitigate the erosive forces associated with the stormwater runoff.

The physical stream assessment that was conducted generally supports the findings of the geomorphic assessment, namely that the majority of stream reaches within the watershed show signs of being impacted by urbanization. While the majority of the stream reaches ranked either good or fair overall, the assessment enabled specific metrics (e.g., riparian habitat conditions) to be analyzed and targeted for future management recommendations.

A significant reason for the adverse impacts being seen in Watts Branch is that the existing stormwater treatment practices are inadequate or were built to provide only peak discharge controls for larger storm events (e.g., the 2- or 10-year storms), and have little capability to control channel erosion or remove stormwater pollutants. Improving water quality through reducing the pollutant load delivered to the stream is an important goal of the project for several reasons. First, there is a

strong desire by the City and Montgomery County to protect and enhance the aquatic and terrestrial ecosystems along the stream corridor, as well as improve the appearance for park users. Second, the confluence of the Potomac River and Watts Branch is just upstream of a major Washington Suburban Sanitary Commission drinking water intake for suburban Maryland; consequently, the water quality of Watts Branch can have a significant impact on the level of treatment required at the drinking water plant. Lastly, Watts Branch is a tributary to the Chesapeake Bay, where nutrient load reduction is a major basin goal for the Bay. Therefore, limiting the nutrient loads from Watts Branch will assist in achieving the larger basin goal of the Chesapeake Bay.

In response to the water quality goals of the project, stormwater retrofits that provide both channel protection and water quality benefits were pursued as one of the tools of the Watts Branch watershed management plan. Stormwater retrofit and stream rehabilitation inventories were conducted throughout the watershed to identify candidate sites. The Center and ESA worked with staff and the Partnership to develop ranking systems, which accounted for benefits and associated costs or undesirable effects. The stormwater management (SWM) ranking system used a two-tiered method which compared technical or watershed issues, such as size of drainage area, site availability and utility conflicts, maintenance burdens, efficiency at providing water quality and quantity, and unit costs, against environmental and community goals, including wetland, tree and recreational use impacts, and a community acceptance factor. Stream rehabilitation projects were similarly ranked with a system comparing the length and severity of the erosion against forest impacts from construction and site ownership. Several variations on each ranking system were tried to give the Partnership different ways of evaluating the projects. Using these ranking systems, sites were prioritized and selected to be carried forward in the design process (Phase II of the project).

A total of 54 candidate stormwater retrofits sites were originally identified and field investigated to verify technical feasibility and to identify the most likely management practice for each site. Seventeen of the 54 candidate sites were abandoned after the field screening for a variety of reasons, including inadequate space for effective SWM or retrofits already being provided by private development (such as Fallsgrove). Of the remaining 37 sites, the 18 top-ranked candidate sites were identified by the ranking systems for further investigation through the development of detailed conceptual designs (Phase II). Subsequent to the submittal of the detailed conceptual designs and public review and comment, an additional three SWM candidate sites were eliminated from further consideration at this time, and one site, Aintree SWM Pond, is being assessed independent of the watershed study process. This results in 14 SWM sites as priority implementation projects for the watershed study.

Similarly, 62 RSAT locations, covering 4.7 miles of Watts Branch mainstem and tributaries, were identified as candidates for stream rehabilitation. The stream rehabilitation site evaluation narrowed this down using the ranking system and grouping adjacent candidate sites. The prioritization process identified 35 separate stream rehabilitation project sites that went forward to the design concept stage (Phase II), resulting in twelve distinct stream projects, or protection for 2.7 miles of stream.

E.3 Recommendations

While all 14 retrofit and twelve stream rehabilitation sites are valid candidates for further investigation and design (see Figure E.2), the reality is that fiscal and staff resources limit the

number of projects that can be implemented in a timely fashion. In addition, it is most appropriate to implement projects that complement each other and limit the overall disturbance of existing natural resources as much as possible. It is therefore important to try to prioritize the implementation of these projects in a subwatershed context. In other words, sites that should be pursued first should be pursued in the context of the overall benefit to the watershed through a subwatershed management strategy and an approach that seeks to combine stormwater retrofits with other rehabilitation strategies.

As part of Phase II, three parameters were evaluated to identify subwatersheds for high priority implementation: the current condition of riparian buffer within each subwatershed, the distribution of stormwater retrofits across the watershed as a whole, and the relative proximity of recommended stream rehabilitation sites downstream from recommended retrofit sites. Table E.1 lists the subwatersheds recommended for priority implementation. Figure E.2 shows the locations of the prioritized subwatersheds. It should be noted that there are additional considerations that may ultimately shift the priority implementation such as the efficiency of coordinating with other public works projects (e.g., sewer repairs and improvements), community issues and concerns (e.g., severe erosion correction and/or park program considerations), and wetland and forest area improvements.

Table E.1 Recommended Subwatershed for Priority Implementation

Subwatershed Designation	Recommended Projects for Implementation	Justification
204	Stormwater retrofits: SM-18, SM-19 & SM-20 Stream rehabilitation sites: 204-5; and 302-12 to 204-1[1]	combines retrofits with downstream stream rehabilitation, and consolidates construction disturbances
205	Stream rehabilitation sites: 205-5 to 205-8; & 302-12, 205-1 to 205-2[2]	combines upstream stormwater management (King Farm) with downstream stream rehabilitation, and consolidates construction disturbances
114 & 115A	Stormwater retrofits: O-3, SM-23 and SM-22* Stream rehabilitation sites: 115A-1 to 115A-3; & 302-3, 302-4 to 302-8[3]	combines retrofits with downstream stream rehabilitation, and consolidates construction disturbances
119	Stormwater retrofits: SM-1, SM-2, and SM-3	downstream retrofits that provide water quality and channel protection treatment for the majority of the subwatershed
103	Stormwater retrofits: SD-8 and SD-6 Stream rehabilitation sites: 103-5 to 103-8; & 103-1 to 103-2[4] Riparian buffer enhancement	combines retrofits with downstream stream rehabilitation, buffer enhancement, and consolidates construction disturbances
Mainstem	Stream rehabilitation sites: 401-15 to 401-18, 401-8 to 401-11, 401-3 to 401-3, 401-5 to 401-6	combines upstream retrofits with stream rehabilitation to stem significant erosion and protect City sewer infrastructure

Notes:
* It is acknowledged that site SM-22 is privately owned. The City should work diligently with the owner to pursue this project.

Option 1 Stream rehab. for site 204-1 would be combined with SM-20 to minimize construction disruptions

Option 2 Stream rehab. for site 205-1 & 205-2 combined as one reach with sites 302-12 to 204-1

Option 3 Stream rehab. for site 115A-1 to 115A-3 combined as one site with 302-3 to 302-6 to link disturbed areas and minimize construction disruptions

Option 4 Stream rehab. at site 103-1 & 103-2 would also include sites 401-15 to 401-18 to link disturbed areas and minimize construction disruptions

Subwatershed 204, while having among the best current riparian cover, also contains three important

stormwater retrofit sites (SM-18, 270-Industrial Park Pond; SM-19, PEPCO Site Pond; and SM-20, Carnation Drive Pond) with the capability to substantially control a significant portion of the runoff from the contributing subwatershed. These three sites coupled with implementation of stormwater management on the King Farm, are upstream from three of the recommended stream rehabilitation sites (site 204-5, 204-1, and 302-12, downstream from SM-18, SM-19, & SM-20). Subwatershed 205 also has excellent riparian cover and has upstream stormwater management provided on King Farm. Consequently, it is recommended to pursue stream rehabilitation sites 205-5 to 205-8, 205-1 to 205-2 and site 302-12 (this site is downstream to subwatershed 204 and 205) as connected projects after SWM improvements are made upstream.

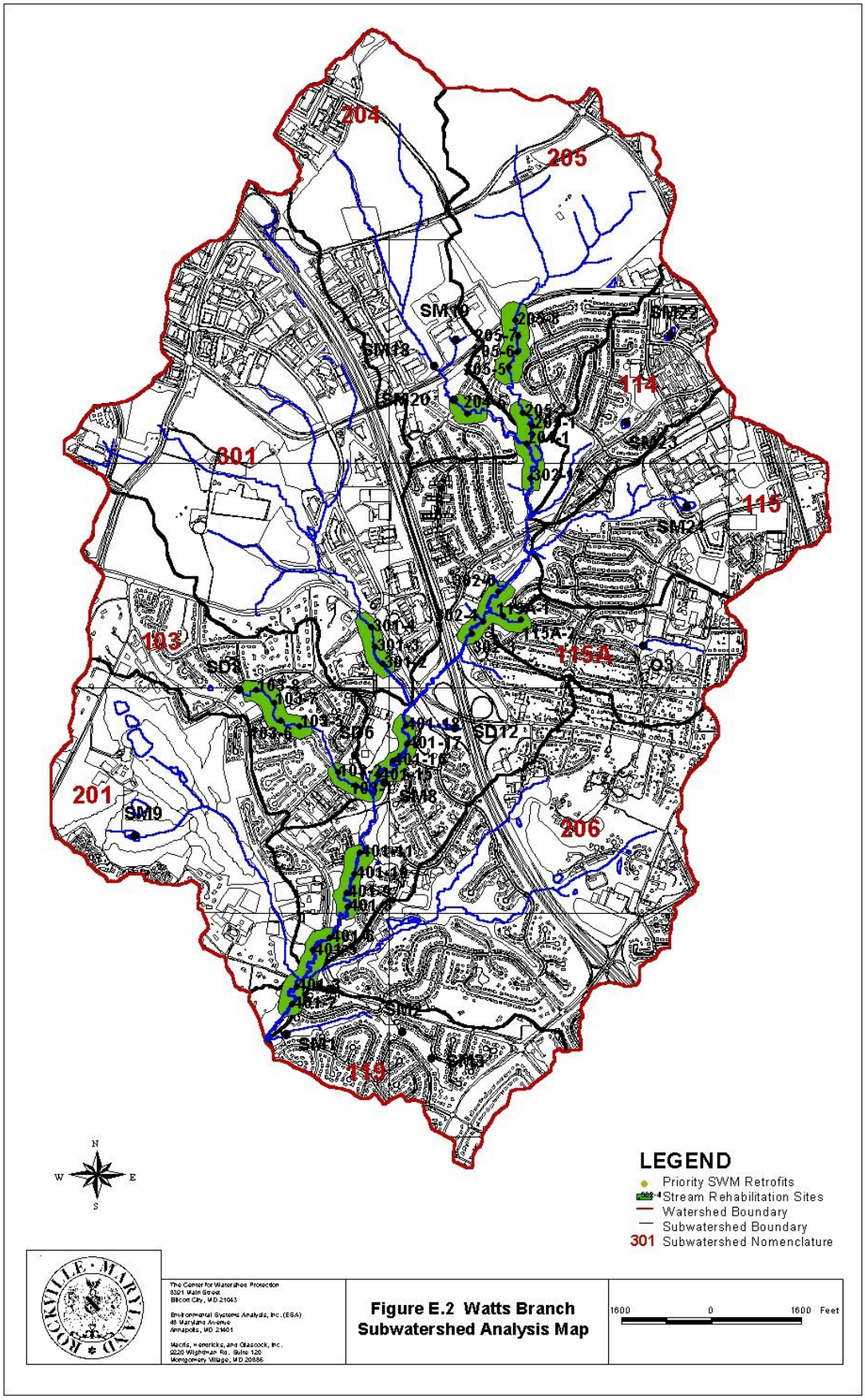
Subwatershed 114, which contains College Gardens, is the most impervious subwatershed in the study and it contains virtually no stormwater management controls (neither water quantity nor water quality control). SWM Retrofit site SM-23, College Gardens Park Pond, provides an opportunity to control and treat a portion of the runoff from this subwatershed, which should also benefit priority downstream rehabilitation sites. Finally, there is a direct link in subwatershed 115A where site O-3 (Welsh Park Pond) drains to the storm drainpipe leading to the eroded outfall channel at site 115A-1 to 115A-3, where stream rehabilitation is proposed. Just below and above the confluence with the Watts Branch mainstem (tributary 302) is another stream rehabilitation site (302-3, 4 & 6). When combined with the upstream retrofit project and the stream rehabilitation work in subwatersheds 115A and 114, it makes sense to consolidate the construction in this area. In addition, stream rehabilitation site 302-3 to 302-6 will receive some benefits from upstream retrofit sites in subwatersheds 204 and 205.

Subwatershed 119, the Horizon Hill community, has an opportunity to provide both water quality and channel protection storage for almost the entire subwatershed through upgrades to the three existing SWM ponds at SM-1, SM-2 and SM-3. This will provide protection to the wooded section of tributary below the most downstream pond, and to the mainstem below Horizon Hill tributary. There are no stream rehabilitation sites associated with this priority subwatershed since much of the stream valley within Horizon Hill Park was previously stabilized by the City, and the SWM retrofits should adequately protect the downstream channel.

Subwatershed 103 contains the SWM retrofit sites SD-8 (Glenora Park) and SD-6 (Woottons Mill Park), and two stream rehabilitation segments (sites 103-1 to 103-2 in Woottons Mill Park; and 103-5 to 103-8 below Glenora Park). Based on the amount of existing severe channel degradation, the potential for partial control of channel-forming storm events, and the potential for riparian buffer enhancement, it is our recommendation that subwatershed 103 be carried forward as a priority site.

Woottons Mill Park is experiencing significant erosion along the mainstem of Watts Branch, and has extensive stream rehabilitation proposed. Stream protection is vital along these reaches because of the large volume of runoff from many neighborhoods that have no SWM opportunities. The City's Watts Branch sanitary sewer trunk line, which parallels the mainstem, has been exposed in several locations. The Department of Public Works intends to stabilize these eroded reaches and repair the sewer manholes and lines before more serious damage occurs to the sewer line. Therefore, the stream rehabilitation projects from 401-8 to 401-11 and 401-15 to 401-18 are also listed as priority in the City's Implementation Schedule, although they are not part of a particular subwatershed.

Figure E.2 Subwatershed Analysis Map



E.4 Watershed Education and Pollution Prevention Strategy

In addition to the structural recommendations, a series of pollution prevention measures and public education approaches are recommended in the Watts Branch Watershed Management Plan (Phase III of the project). Pollutant load reduction is always more effective when controlled at the source (i.e., yards, parking lots, parks) rather than trying to treat the runoff after the fact. Pollution prevention program success starts with educating the public about watershed awareness and the importance of an individual's behavior on the health of a watershed. An effective and widespread pollution prevention program coupled with the water quality benefit of the stormwater retrofits should help meet the water quality goals of the Watts Branch watershed as well as the Potomac River and Chesapeake Bay. It will be easier and more efficient for the City to develop a city-wide program rather than limiting it to Watts Branch watershed alone; the staff has therefore recommended that this component be developed and implemented separately from the watershed study projects. The City's Environmental Specialist will have the greatest role in managing this new program. Table E.2 presents program recommendations for the City to consider.

Table E.2 Nonstructural Pollution Prevention Program Recommendations

Program Recommendation	Program Components
Watershed Awareness	• Promote general awareness and responsibility of citizens with respect to being good stewards to their watersheds • Encourage and promote citizen activities around watersheds such as monitoring, tree plantings, "green-up" days, water conservation, clean ups and policing (e.g., reporting illegal dumping)
Pet Waste Management	• Signage and waste disposal stations • Fact sheets and limited media campaign
Lawn and Garden Care, Landscaping (Bay Scapes)	• Promotion of soil testing through Montgomery College • Recognize citizens using proper practices • Garden club and nursery outreach and education
Automotive Care (Car Washing and Maintenance)	• Promotion of washing on pervious surfaces and with minimum amounts of water • Proper disposal and recycling of used motor fluids
Good Housekeeping	• Promotion of proper disposal and/or recycling of household and commercial hazardous wastes
Disconnection of Directly Connected Impervious Areas	• Institute downspout disconnection and rain barrel program
Illicit Connection Detection and Removal	• Monitor and eliminate illicit connections in targeted commercial areas
Commercial Dumpster Management	• Locate away from storm drain inlets and riparian buffers • Promote/require use of enclosed holding areas

E.5 Watershed Indicator Monitoring

Having a method to assess the efficacy of the implemented measures and a basis from which to recommend modifications to the plan is a critical piece to the overall plan. A goal of the Center's recommended watershed management plan approach is to utilize stormwater indicators to the maximum extent practical to guide current and future management decisions (Phase III of the project). The recommendations are oriented towards conducting inexpensive, repeatable, and scientifically valid monitoring to assess future stream quality health. The monitoring of indicators will provide a key frame of reference and basis for updating and adjusting the Watts Branch Watershed Management Plan.

A suite of six indicators (Table E.3) have been identified and recommended to assess the efficacy of the Watts Branch Watershed Management Plan. As part of this project, baseline macroinvertebrate and fish data will be collected during the spring of 2001. These data will provide a benchmark from which to measure various aspects of the proposed management plan.

Table E.3 Stormwater Indicator Profile Categories

Indicator Category	Indicator Name
Physical and Hydrological Indicators	• Stream widening/downcutting • Physical habitat monitoring
Biological Indicators	• Macroinvertebrate and fish assemblage
Social Indicators	• Public attitude surveys • Public involvement and monitoring • User perception

E.6 Implementation

Throughout the development of the Watts Branch Watershed Management Plan, the City of Rockville Department of Public Works has been evaluating and planning an implementation schedule for the priority projects. This planning has included budget considerations for the Capital Improvement Projects (CIP) list, need for other work in the Watts Branch stream valley such as sewer line rehabilitation, and concurrent scheduling for improvements approved in the Cabin John and Rock Creek watershed studies. Based on current budget planning and projections, the recommended projects which are City-owned or operated are slated for a staggered implementation over the next 10-year period. The City has started, and will continue to work with owners of private sites where watershed improvements have been recommended to facilitate those projects through the normal development process, environmental grant or public agency programs.

The City recognizes the conceptual nature of the recommended stormwater management and stream restoration projects in the management plan, which are subject to change in the final design phase. All of the proposed watershed improvements will require more detail and attention at the final design stage to minimize construction disruption and address residents' concerns. Staff and the design consultants will work with community members throughout final design, and will gather residents'

ideas for improving projects and incorporate them where feasible. the following design guidelines, among others, will be considered:

- There will be flexibility in stormwater management design, layout and size to help resolve residents' concerns with loss of recreational space in local parks;
- Stormwater management design details will be reviewed to promote safety, attractiveness and softening of the manmade structures visible in the ponds;
- Staff will seek opportunities to reduce stormwater management pond footprints if alternate cost-effective stormwater management choices become available to offset the storage loss;
- Staff will consider each park as a whole as well as evaluating the effect of watershed projects upon the immediate area to be disturbed.